

CLAIMS

1. An information recording / reading head for recording information onto tracks of an information recording medium having the tracks with a track pitch of P, or reading information recorded on the tracks of the information recording medium,
- the information recording / reading head comprising:
- a support portion; and
- four or more recording / reading elements which are supported by the support portion and which record information onto the tracks of the information recording medium or which read information recorded on the tracks of the information recording medium,
- at least four of the recording / reading elements being arranged on the support portion such that if the positions of recording / reading end portions of the recording / reading elements are A, B, C, and D, a parallelogram is formed in which a line segment AB connecting A and B is parallel to a line segment CD connecting C and D, and a line segment AC connecting A and C is parallel to a line segment BD connecting B and D, and that if a ratio of the length of the line segment AB to the length of the line segment AC is η and the height of the parallelogram is H when the line segment AC is regarded as a base, the following relationship is satisfied:

$$H = \eta \cdot P.$$

2. An information recording / reading head for recording information onto tracks of an information recording medium having

the tracks with a track pitch of P, or reading information recorded on the tracks of the information recording medium.

the information recording / reading head comprising:

a support portion; and

5 four or more recording / reading elements which are supported by the support portion and which record information onto the tracks of the information recording medium or which read information recorded on the tracks of the information recording medium,

at least four of the recording / reading elements being
10 arranged on the support portion such that if the positions of recording / reading end portions of the recording / reading elements are A, B, C, and D, a parallelogram is formed in which a line segment AB connecting A and B is parallel to a line segment CD connecting C and D, and a line segment AC connecting A and C is parallel to a line
15 segment BD connecting B and D, and that if the length of the line segment AC is L and an angle ACD made by the line segment AC and the line segment CD is α , the following relationship is satisfied:

$$L \cdot \sin \alpha = P.$$

20 3. An information recording / reading head for recording information onto tracks of an information recording medium having the tracks with a track pitch of P, or reading information recorded on the tracks of the information recording medium,

the information recording / reading head comprising:

25 a support portion; and

four or more recording / reading elements which are supported

by the support portion and which record information onto the tracks of the information recording medium or which read information recorded on the tracks of the information recording medium,

at least four of the recording / reading elements being
5 arranged on the support portion such that if the positions of recording / reading end portions of the recording / reading elements are A, B, C, and D, a parallelogram is formed in which a line segment AB connecting A and B is parallel to a line segment CD connecting C and D, and a line segment AC connecting A and C is parallel to a line
10 segment BD connecting B and D, and that if a ratio of the length of the line segment AB to the length of the line segment AC is η and the height of the parallelogram is H when the line segment AC is regarded as a base, the following relationship is satisfied:

$$H = m \cdot \eta \cdot P \text{ (wherein } m \text{ is a natural number).}$$

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4. An information recording / reading head for recording information onto tracks of an information recording medium having the tracks with a track pitch of P, or reading information recorded on the tracks of the information recording medium,

20 the information recording / reading head comprising:
a support portion; and

four or more recording / reading elements which are supported by the support portion and which record information onto the tracks of the information recording medium or which read information
25 recorded on the tracks of the information recording medium,

at least four of the recording / reading elements being

arranged on the support portion such that if the positions of recording / reading end portions of the recording / reading elements are A, B, C, and D, a parallelogram is formed in which a line segment AB connecting A and B is parallel to a line segment CD connecting C and D, and a line segment AC connecting A and C is parallel to a line segment BD connecting B and D, and that if the length of the line segment AC is L and an angle ACD made by the line segment AC and the line segment CD is α , the following relationship is satisfied:

$$L \cdot \sin \alpha = m \cdot P \text{ (wherein } m \text{ is a natural number).}$$

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5. The information recording / reading head according to claim 1, wherein the at least four recording / reading elements are arranged on the support portion such that if the length of the line segment AC is L and the line segment CD is K, the following relationship is satisfied,

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$$(n^2 \cdot K^2 / L^2) + (H^2 / K^2) \neq 1 \text{ (n is a natural number).}$$

6. An information recording / reading head for recording information onto tracks of an information recording medium, or reading information recorded on the tracks of the information recording medium,

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the recording / reading head comprising:

a support portion; and

three or more recording / reading elements which are supported by the support portion and which record information onto the tracks of the information recording medium or which read

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information recorded on the tracks of the information recording medium,

at least three of the recording / reading elements being arranged on the support portion such that when recording / reading end portions of two of the three recording / reading elements are positioned on one track, a recording / reading end portion of the remaining one of the three recording / reading elements is placed on another track.

10 7. An information recording / reading head for recording information onto tracks of an information recording medium, or reading information recorded on the tracks of the information recording medium,

the recording / reading head comprising:

15 a support portion; and

four or more recording / reading elements which are supported by the support portion and which record information onto the tracks of the information recording medium or which read information recorded on the tracks of the information recording medium,

20 at least four of the recording / reading elements being arranged on the support portion such that when recording / reading end portions of two of the four recording / reading elements are positioned on one track, recording / reading end portions of the remaining two of the four recording / reading elements are placed on
25 another track.

8. The information recording / reading head according to claim 7,
wherein the at least four recording / reading elements are arranged
on the support portion such that if the recording / reading end
portions of the two recording / reading elements positioned on the one
5 track are R and S, and the recording / reading end portions of the two
recording / reading elements positioned on the another track are T
and U, a parallelogram is formed in which a line segment RS
connecting R and S is parallel to a line segment TU connecting T and
U, and a line segment RT connecting R and T is parallel to a line
10 segment SU connecting S and U.

9. The information recording / reading head according to claim 6,
wherein the one track and the another track are adjacent to each
other.

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10. The information recording / reading head according to claim 1,
wherein the recording / reading elements are probes.

11. An information recording / reproducing apparatus for
20 recording information onto tracks of an information recording
medium, or reproducing information recorded on the tracks of the
information recording medium,

the information recording / reproducing apparatus comprising:
an information recording / reading head which has: a support
25 portion; and two or more recording / reading elements which are
supported by the support portion and which record information onto

the tracks of the information recording medium or which read information recorded on the tracks of the information recording medium, at least two of the recording / reading elements being arranged on the support portion such that their recording / reading end portions are placed on one track;

a signal applying device which applies a signal corresponding to information, to any one of the two recording / reading elements, in order to record the information onto the tracks of the information recording medium through the one recording / reading element; and

an information reading device which readily reads information recorded on the tracks of the information recording medium by the signal applying device, through the other recording / reading element out of the two recording / reading elements.

12. An information recording / reproducing apparatus for recording information onto tracks of an information recording medium, or reproducing information recorded on the tracks of the information recording medium,

the information recording / reproducing apparatus comprising:

an information recording / reading head which has: a support portion; and three or more recording / reading elements which are supported by the support portion and which record information onto the tracks of the information recording medium or which read information recorded on the tracks of the information recording medium, at least three of the recording / reading elements being arranged on the support portion such that if recording / reading end

portions of two of the three recording / reading elements are positioned on one track, a recording / reading end portion of the remaining one of the three recording / reading elements is placed on another track;

5 a first signal applying device which applies a signal corresponding to information, to any one of the two recording / reading elements placed on the one track, in order to record the information onto the one track through the one recording / reading element;

10 an information reading device which readily reads information recorded on the one track by the first signal applying device, through the other recording / reading element out of the two recording / reading elements placed on the one track;

 a judging device which judges whether or not the recording of
15 information by the first signal applying device is correctly performed, on the basis of information read by the information reading device; and

 a second signal applying device which applies a signal corresponding to information, to the remaining one recording /
20 reading element, in order to record the information again onto the one track through the remaining one recording / reading element, if the recording of information by the first signal applying device is not correctly performed.

25 13. An information recording / reproducing apparatus for recording information onto tracks of an information recording

medium, or reproducing information recorded on the tracks of the information recording medium.

the information recording / reproducing apparatus comprising:

an information recording / reading head which has: a support

5 portion; and four or more recording / reading elements which are supported by the support portion and which record information onto the tracks of the information recording medium or which read information recorded on the tracks of the information recording medium, at least four of the recording / reading elements being
10 arranged on the support portion such that if recording / reading end portions of two of the four recording / reading elements are positioned on one track, recording / reading end portions of the remaining two of the four recording / reading elements are placed on another track;

15 a first signal applying device which applies a signal corresponding to one portion of information, to any one of the two recording / reading elements placed on the one track, in order to record the one portion of the information onto the one track through the one recording / reading element;

20 a first information reading device which readily reads the one portion of the information recorded on the one track by the first signal applying device, through the other recording / reading element out of the two recording / reading elements placed on the one track;

a second signal applying device which applies a signal
25 corresponding to another portion of the information, to any one of the two recording / reading elements placed on the another track, in

order to record the another portion of the information onto the another track through the one recording / reading element; and

5 a second information reading device which readily reads the another portion of the information recorded on the another track by the second signal applying device, through the other recording / reading element out of the two recording / reading elements placed on the another track.

14. An information recording / reproducing apparatus for
10 recording information onto tracks of an information recording medium, or reproducing information recorded on the tracks of the information recording medium.

the information recording / reproducing apparatus comprising:
an information recording / reading head which has: a support
15 portion; and four or more recording / reading elements which are supported by the support portion and which record information onto the tracks of the information recording medium or which read information recorded on the tracks of the information recording medium, at least four of the recording / reading elements being
20 arranged on the support portion such that if recording / reading end portions of two of the four recording / reading elements are positioned on one track, recording / reading end portions of the remaining two of the four recording / reading elements are placed on another track;

25 a first signal applying device which applies a signal corresponding to information, to any one of the two recording /

reading elements placed on the one track, in order to record the information onto the one track through the one recording / reading element;

an information reading device which readily reads information recorded on the one track by the first signal applying device, through the other recording / reading element out of the two recording / reading elements placed on the one track;

a judging device which judges whether or not the recording of information by the first signal applying device is correctly performed, on the basis of information read by the information reading device;

a second signal applying device which applies a signal corresponding to information, to any one of the remaining two recording / reading elements, in order to record the information again onto the one track through the one recording / reading element; and

a record position detecting device which detects a record position on the one track of information to be recorded by the second signal applying device, through the other recording / reading element out of the remaining two recording / reading elements.

15. The information recording / reproducing apparatus according to claim 13, wherein the information recording / reading head is the information recording / reading head according to claim 1.

16. The information recording / reproducing apparatus according to claim 14, wherein the information recording / reading head is the information recording / reading head according to claim 1.

17. The information recording / reproducing apparatus according to claim 11, the recording / reading elements are probes.

5 18. An information reproducing apparatus for reproducing information recorded on tracks of an information recording medium, the information reproducing apparatus comprising:

an information reading head which has: a support portion; and two or more reading elements which are supported by the support
10 portion and which read information recorded on the tracks of the information recording medium, at least two of the reading elements being arranged on the support portion such that their reading end positions are placed on one track;

a signal reading device in which the two reading elements
15 individually read the same information recorded at a same place on the track of the information recording medium, to thereby obtain two reading signals corresponding to the same information;

a signal adding device which adds the two reading signals obtained by the signal reading device to each other, after the
20 difference at a reading time point of the two reading elements is adjusted; and

a reproducing device which reproduces the information on the basis of the reading signal added by the signal adding device.

25 19. An information reproducing apparatus for reproducing information recorded on tracks of an information recording medium,

the information reproducing apparatus comprising:

an information reading head which has: a support portion; and
two or more reading elements which are supported by the support
portion and which read information recorded on the tracks of the
5 information recording medium, at least two of the reading elements
being arranged on the support portion such that their reading end
positions are placed on one track;

a signal reading device in which the two reading elements
individually read the same information recorded at a same place on
10 the track of the information recording medium, to thereby obtain two
reading signals corresponding to the same information;

a signal selecting device which selects any one of the two
reading signals obtained by the signal reading device; and

a reproducing device which reproduces the information on the
15 basis of the reading signal selected by the signal selecting device.

20. An information reproducing apparatus for reproducing
information recorded on tracks of an information recording medium,

the information reproducing apparatus comprising:

20 an information reading head which has: a support portion; and
two or more reading elements which are supported by the support
portion and which read information recorded on the tracks of the
information recording medium, at least two of the reading elements
being arranged on the support portion such that their reading end
25 positions are placed on one track;

a signal reading device in which the two reading elements

individually read the same information recorded at a same place on the track of the information recording medium, to thereby obtain two reading signals corresponding to the same information;

5 a signal adding device which adds the two reading signals obtained by the signal reading device to each other, after the difference at a reading time point of the two reading elements is adjusted, if both levels of the two reading signals reach a predetermined level;

10 a signal selecting device which selects a higher level reading signal from the two reading signals obtained by the signal reading device, if either or both levels of the two reading signals do not reach the predetermined level; and

15 a reproducing device which reproduces the information on the basis of the reading signal added by the signal applying device or the reading signal selected by the signal selecting device.

21. The information reproducing apparatus according to claim 18, wherein the reading elements are probes.